

Using Geographic Variation To Predict Breeding Locales Of Migrating Red-winged Blackbirds

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ABSTRACT—Ulnar length of 4261 male red-winged blackbirds (*Agelaius phoeniceus*), collected during the breeding season (mid-May to mid-July) in 150 one-degree latitude-longitude blocks in south central Canada and north central United States, were assessed for geographic variation. Regression analysis indicated that ulnar length gradually increases with latitude [Equation: $[32.77 \text{ mm} + (0.063)(\text{latitude})]$] and longitude [Equation: $[34.08 \text{ mm} + (0.017)(\text{longitude})]$]. Red-winged blackbird ulnar length tended to be longer in Canada ($\bar{x} = 34.64 \text{ mm}$, $SD = 0.25$) than in the United States ($\bar{x} = 34.29 \text{ mm}$, $SD = 0.20$). We estimated that 26.9% of 0.7 million and 40.1% of 1.4 million male red-winged blackbirds using spring migratory roosts in Minnesota and South Dakota, respectively, were destined to breed in the United States. This information adds to the growing data base on the timing and patterns of red-winged blackbird movements in relation to sunflower damage.

Key words: *Agelaius phoeniceus*, blackbird, geographic variation, red-winged blackbird, sunflower

Blackbird (Icterinae) damage to sunflower remains a major production problem in South Dakota, North Dakota, and Minnesota (Hothorn et al. 1988, Lamey et al. 1992). Recent surveys indicate that annual damage exceeds \$2,000,000 (North Dakota Agricultural Statistics Service 1990, Lamey et al. 1992). Lamey et al. (1992) reported 91 of 652 surveyed sunflower growers suffered bird damage losses greater than 10%. Red-winged blackbirds (*Agelaius phoeniceus*) are the most numerous of the Icterinae in these states (Dolbeer and Stehn 1983) and can cause significant damage to sunflower (Linz et al. 1984).

Knowledge of the timing and patterns of movements of fall and spring migratory blackbirds as they move between wintering and breeding areas may help guide population management strategies designed to reduce sunflower damage (Knittle et al. 1987, Otis et al. 1986). Resident blackbirds probably cause the majority of sunflower damage in the northern Great Plains (Cummings et al. 1989, Twedt 1990). Thus, suppression of populations of migrating blackbirds with

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registered avicides (Glahn and Wilson 1992) may adversely impact breeding populations not involved in sunflower damage. Development of techniques for differentiating between resident and migrant red-winged blackbirds during the fall and spring migration is a critical first step to modelling these impacts.

James et al. (1984) demonstrated that identifying wintering red-winged blackbirds as residents or migrants in the southeast United States is possible by comparing size of various morphometric traits. Breeding red-winged blackbirds in central North America have a gradual cline of increasing size northward and westward (Power 1970). Thus, analysis of morphometric traits of birds migrating through sunflower growing areas may yield information on their geographic origin or destination.

Here, we present data on ulnar length of 4261 breeding male red-winged blackbirds collected in south central Canada and north central United States. Our objectives were to (1) establish the geographic variation of a single easily obtained morphological character (ulna length) in the northern Great Plains and (2) predict the breeding locale of two populations of migrating male red-winged blackbirds using spring roosts in southeastern South Dakota and southwestern Minnesota.

STUDY AREA AND METHODS

Study Area and Sampling

From mid-May to mid-July 1982, 1983, and 1985, territorial male red-winged blackbirds were randomly collected, as part of another study, from 150 one-degree latitude-longitude blocks in south central Canada and north central United States (Fig. 1). The locality of each bird was designated as the latitude and longitude of the southeast corner of the degree block in which the bird was collected (Knittle et al. 1987).

On 17, 18 (combined for analysis), 25, and 29 March 1985, adult male red-winged blackbirds were collected at a major spring migratory roost at Lake Thompson, located near DeSmet, SD (44°N 097°W; Otis et al. 1986). On 22, 23 (combined for analysis), and 28 March 1985, birds were collected at a roost located at the East Fork of the Chippewa River near Benson, MN (45°N 095°W; Otis et al. 1986). Birds were collected by shooting as they entered and exited the roost and by following birds from the roost and collecting them opportunistically.

The wings of each bird were severed and the right ulna bone (when intact) was extracted by heating in an aqueous solution of enzymatic detergent at approximately 75°C for 8-24 hours. Bones were dried at room temperature and measured to the nearest 0.1 mm with dial calipers. Ninety percent of the measurements were made by the first and second authors.

Statistical Analysis

We averaged ulnar length for all birds collected within each of the 150 one-degree latitude-longitude blocks (\bar{x} sample size = 28.4). Following Knittle et al.

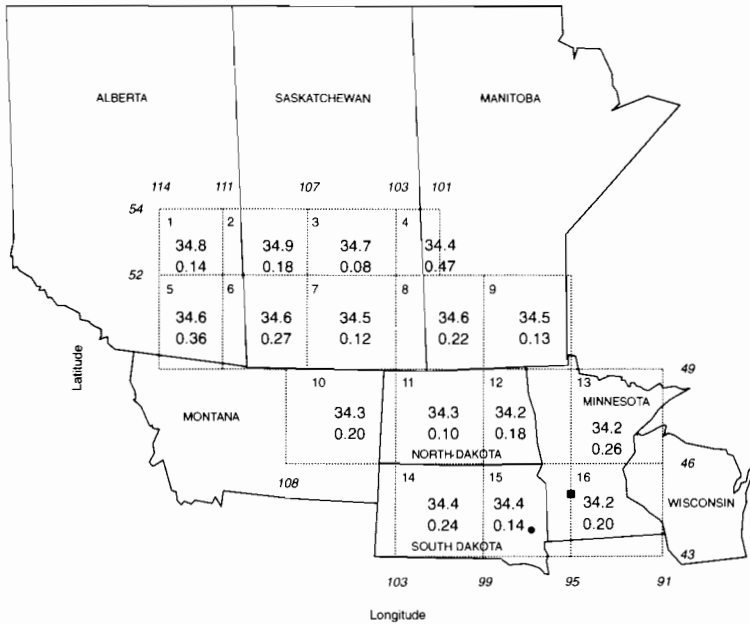


Figure 1. Average ulnar lengths (top number) and SD (bottom number) of adult male red-winged blackbirds collected in 16 regions within south central Canada and north central United States.

(1987), the sampled area in the United States was divided into seven areas (Fig. 1) based on political boundaries and sunflower acreage. We divided the sampled area within Canada into nine areas. A one-way ANOVA was used to determine if ulnar length within the one-degree blocks differed among latitudes (43°N - 53°N) and longitudes (91°W - 114°W; McClave and Dietrich 1982:385-434; PROC GLM, SAS Institute, Inc. 1988:549-640). Waller-Duncan multiple range test was used to isolate significant differences among means (Waller and Duncan 1969). Linear regression analysis was used to determine the relationships between ulnar length, latitude, and longitude (McClave and Dietrich 1982:528-584), using PROC REG (SAS Institute, Inc. 1988:773-875).

One-way ANOVAs were used to decide if average ulnar length differed (1) between male red-winged blackbirds collected at Benson, MN, and Lake Thompson, SD, spring roosts and (2) among collection dates within roosts (McClave and Dietrich 1982:385-434) using PROC GLM (SAS Institute, Inc. 1988:549-640). We calculated mean ulnar length and 95% confidence intervals (± 1.96 SE) for birds collected in Canada and the United States to obtain critical values for predicting the breeding locale (Canada or United States) of each bird collected at Benson and Lake Thompson.

RESULTS

Analysis of Geographic Variation

Red-winged blackbird ulnar length differed among latitudes ($P = 0.033$) and longitudes ($P = 0.044$) of the 150 sampled one-degree blocks. In general, ulnar length was shorter in eastern Minnesota and longer in east central Alberta and west central Saskatchewan (Fig. 1). Regression analysis indicated that ulnar length increases slightly with latitude [$r^2 = 0.102$; Equation: $[32.77 \text{ mm} + (0.063)(\text{latitude})]$] and longitude [$r^2 = 0.035$; Equation: $[34.08 \text{ mm} + (0.017)(\text{Longitude})]$]. Ulna bones of red-winged blackbirds tended to be longer in south central Canada than in north central United States, averaging 34.64 mm ($SD = 0.25$, 95% $CI = 34.58 - 34.69$ mm) and 34.29 ($SD = 0.20$, 95% $CI = 34.25 - 34.33$ mm), respectively.

Since sunflower production is essentially limited to North Dakota, South Dakota, and Minnesota in the northern Great Plains, these morphometric differences are potentially useful for classifying migrating birds as either breeding in sunflower growing areas (United States) or breeding where sunflower is absent (Canada). Using smaller geographic areas would likely result in the misclassification of a large number of birds.

Predicting Destination of Spring Migratory Red-winged Blackbirds

Ulnar length of adult male red-winged blackbirds collected from Benson ($n = 193$, $\bar{x} = 34.83$ mm, $SD = 0.85$) and Lake Thompson ($n = 456$, $\bar{x} = 34.56$ mm, $SD = 0.80$) differed significantly between locations ($P < 0.001$; Fig. 2). Average ulnar length did not differ among collection dates within locations (Thompson - $P = 0.196$, Benson - $P = 0.241$).

We predicted the breeding locale (Canada or United States) of each male red-winged blackbird collected at Benson, MN, and Lake Thompson, SD, by comparing the birds' ulnar length to the mean ulnar length and associated 95% CI for birds collected during the breeding season in Canada and the United States (Fig. 2). Thus, any bird with an ulnar length ≥ 34.58 mm (lower limit of CI for birds collected in Canada) or ≤ 34.33 mm (upper limit of CI for birds collected in the United States) was predicted to be destined for Canada or the United States, respectively. Those birds with an ulnar length between 34.33 mm and 34.58 mm had an equal probability of breeding in either country. We found that 26.9% and 40.1% of the birds collected at Benson and Lake Thompson, respectively, had ulna bones ≤ 34.33 mm. Similarly, 61.6% and 47.6% of the birds using the Benson and Lake Thompson roosts, respectively, had ulna bones ≥ 34.58 mm. The remaining birds were unclassified.

DISCUSSION

Wing length of red-winged blackbirds is positively correlated with body weight (that is, the largest birds have the longest wings; Stone 1973). James et al.

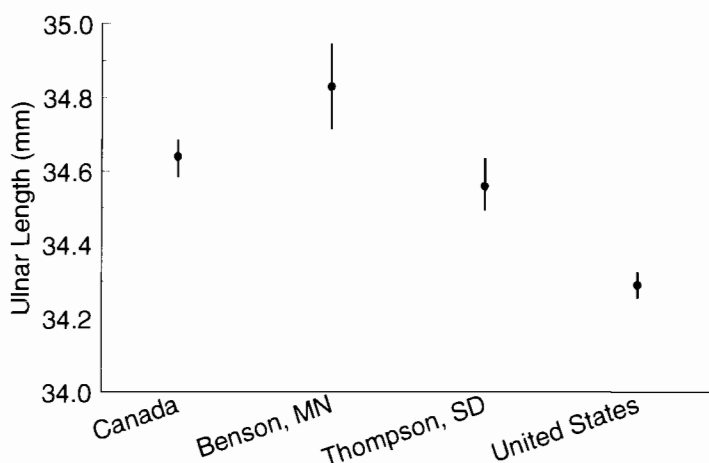


Figure 2. Mean ulnar length and 95% confidence intervals of male red-winged blackbirds collected during the breeding season within south central Canada and north central United States and at spring migratory roosts located near Benson, MN (45°N 095°W) and at Lake Thompson, SD (44°N 097°W).

(1984) suggested that wintering blackbird populations are best differentiated by wing length. However, feathers are subject to wear and are molted by red-winged blackbirds in late-summer (Linz et al. 1983). Thus, wing length is not useful for discriminating origin of populations during late-summer migration. The ulna bone, a skeletal component of the wing, is a temporally stable characteristic and relatively easy to extract and measure.

We collected the largest birds (longest ulna bones) in western Saskatchewan and central Alberta; the smallest birds (shortest ulna bones) in eastern Minnesota and western Wisconsin. Regression analysis indicated a gradual increase in ulnar length northward and westward. The low r^2 value of the regression model suggests that ulnar length is not precisely correlated with latitude and longitude. Localized environmental conditions, such as temperature and moisture regimes, may contribute to variability of ulnar length within latitudes and longitudes (James 1970, Power 1970, James et al. 1984). Differences in ulnar length between male red-winged blackbirds collected in south central Canada and north central United States appear adequate for predicting the destination of spring migratory red-winged blackbirds on a large geographic scale (that is, Canada or United States).

The average ulnar length was significantly longer for male red-winged blackbirds roosting at Benson than for those birds roosting at Lake Thompson. Otis et al. (1986) estimated that about 0.7 and 1.4 million male red-winged blackbirds used the Benson and Lake Thompson roosts, respectively, in 1985. Assuming that

birds with ulnas ≤ 34.33 are more likely to breed in the United States than in Canada, about 188,300 (26.9%) male red-winged blackbirds using the Benson roost and 561,400 (40.1%) birds using Lake Thompson would breed in the United States. Thus, efforts to manage spring migrating male red-winged blackbirds likely to breed in sunflower growing areas should center on the Lake Thompson roost (or perhaps other roosts in southeastern South Dakota).

We conclude that differences in ulna length between male red-winged blackbirds breeding in Canada and those breeding in the United States are small but sufficient to allow classification of fall and spring migrating birds into one of these two areas. These data may be used to study the timing and patterns of movement of red-winged blackbird migrations in relation to sunflower damage. Similar morphological data on female red-winged blackbirds, and other blackbird species damaging sunflower (yellow-headed blackbirds, *Xanthocephalus xanthocephalus* [Twedt 1990], and common grackles, *Quiscalus quiscula*), combined with mass-marking (Otis et al. 1986, Linz et al. 1991), band recovery data (Dolbeer 1978), and radio-telemetry data (Besser et al. 1981), should enable scientists to develop management schemes aimed at reducing sunflower damage.

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